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ABSTRACT

This report of the Federal Council for Science and Technology Committee on Intergovernmental Science Relations contains the efforts of the committee in attempting to achieve the following objectives: (1) to inventory and evaluate the impact of federal policies and programs on the scientific and technological activities of state and local governments, (2) to inventory state and local science and technology activity and appraise its relation to federal programs, (3) to formulate, in consultation with representatives of state and local governments, recommendations for federal initiatives to strengthen this activity and federal cooperation with it, (4) to identify the need for scientific resources, including manpower and institutional requirements of state and local governments, and to assess the adequacy and impact of federal programs bearing on these needs, and (5) to recommend policies, procedures and programs to improve management, information exchange, planning, and coordination of federal science and technology activities with related activities of state and local governments. (Author/CP)

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Public Technology

a Tool for Solving National Problems

Report of the
Committee on
Intergovernmental
Science Relations
to the
Federal Council for
Science and Technology

EXECUTIVE OFFICE OF THE PRESIDENT



May, 1972

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"The time has come for a new partnership between the Federal Government and the States and localities—a partnership in which we entrust the States and localities with a larger share of the Nation's responsibilities, and in which we share our Federal revenues with them so that they can meet those responsibilities."

President Richard M. Nixon
The State of the Union (1971)

"To stave off experimentation in things social and economic is a grave responsibility. Denial of the right to experiment may be fraught with serious consequences to the Nation. It is one of the happy incidents of the federal system that a single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country."

Justice Louis D. Brandeis
New State Ice Company v. Liebmann (1932)

"We seem to be flexible, but we haven't any model of the future before us. In the significant sense, we can't change. And to change is what we have to do. That is why I want scientists active in all the levels of government."

C. P. Snow
Science and Government (1961)

"Even the most brilliantly conceived grant-in-aid program will fail to meet its objectives unless there are qualified State and local personnel to carry it out. Intergovernmental personnel matters, then, are of paramount significance."

U.S. Senate,
Committee on Government Operations (1965)

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THE VICE PRESIDENT
WASHINGTON

FOREWORD

This Report of the Federal Council for Science and Technology Committee on Intergovernmental Science Relations represents a timely and comprehensive analysis of President Nixon's effort to ensure that the fruits of the Nation's tremendous scientific and technological achievements have the maximum beneficial impact in solving our economic, social and environmental problems. Along with the Council of State Governments report in this same area, it provides a useful basis in developing Federal policies to foster more effective scientific and technological relationships between the Federal Government and State and local governments.

I regard this Report as a significant start—a first step in the discussion of intergovernmental relations issues which the President called for in his Message on Science and Technology. It will serve as a guide to the Office of Science and Technology and the Office of Intergovernmental Relations as they proceed in implementing the President's Message.

Philip J. Rogers

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

May 1, 1972

Dr. Edward E. David, Jr.
Chairman, Federal Council
for Science and Technology
Executive Office of the President
Washington, D.C. 20506

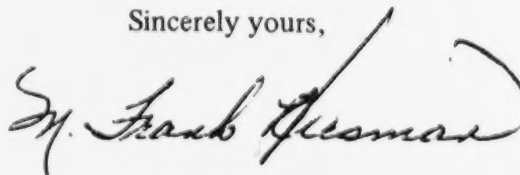
Dear Dr. David:

The Committee on Intergovernmental Science Relations has completed its work pursuant to the objectives the Council set forth in October 1969. I am pleased to submit the final report which is based on a broad spectrum of views on the crucial relationship of the Federal Government to State and local utilization of science and technology.

The widespread interest and enthusiasm in the work of the Committee add greatly to its conviction that the enclosed report and recommendations can be of substantial value in bringing science and technology more effectively to bear on the solution of domestic problems. The contributions of the many who gave of their time, interest and experience to the various State and regional conferences are gratefully acknowledged along with the cooperation of the Federal agencies represented on the Committee.

While a number of individuals and organizations outside the Federal Government were involved in shaping the report and its recommendations, its final form represents the conclusions of the representatives of the Federal agencies involved.

Sincerely yours,



M. Frank Hersman
Chairman, Committee
on Intergovernmental
Science Relations

PREFACE

The Committee on Intergovernmental Science Relations was established in October 1969 by the Federal Council for Science and Technology to explore the interaction of Federal, State and local government research and development policies and programs. The Committee was comprised of representatives from 20 Federal agencies and was directed to:

- Inventory and evaluate the impact of Federal policies and programs on the scientific and technological activities of State and local governments.
- Inventory State and local science and technology activity and appraise its relation to Federal programs.
- Formulate, in consultation with representatives of State and local governments, recommendations for Federal initiatives to strengthen this activity and Federal cooperation with it.
- Identify the need for scientific resources, including manpower and institutional requirements, of State and local governments, and assess the adequacy and impact of Federal programs bearing on these needs.
- Recommend policies, procedures and programs to improve management, information exchange, planning, and coordination of Federal science and technology activities with related activities of State and local governments.

The Committee, in pursuit of these objectives, made a determined effort over a two-year period to obtain data, observations and proposals from the field.

Virtually all of the states contributed materials for this report. The Committee conducted a series of 11 meetings around the country attended by representatives of 17 States. In many cases the Governor himself or a personal representative was present. The Committee delegation for each visit was headed by the top science and technology official of a different lead Federal agency, usually an assistant secretary.

Supplementing these Federal-State meetings were a series of formal presentations to the Committee by Federal, State, and local officials, congressional experts and specialists in state manpower problems. The topics included Federal-State cooperative programs, illustrative State and Regional science and technology organizations, employment of scientists and engineers by State governments, and Federal legislative activities which have implications for State capability to use science and technology.

The Committee held 21 meetings in Washington at which it heard these special presentations, discussed state visits and planned the preparation of this report.

The draft of the Committee's report was reviewed by an official in each State government, by selected representatives of local government, by the twenty Federal agencies represented on the Committee, and by selected scholars throughout the country. In addition, the Science and Technology Committee of the National Legislative Conference held three days of hearings on the report in Washington, D.C., December 7-9, 1971, at which time a large number of views about the draft report were received from Federal, State and local representatives, scientists, and academic administrators. Briefings on the work of the Committee and its recommendations were presented to the Federal Council for Science and Technology on May 22, 1971 and March 17, 1972.

Among the appendices of this report will be found recent resolutions of the National Legislative Conference, the National Governors Conference and the National League of Cities which support the basic thrust of the Committee's recommendations.

CONTENTS

	<i>Page</i>
Preface	vii
Summary and Recommendations	1
Chapter I. The Intergovernmental Requirements of a Public Technology	8
Chapter II. State and Local R&D: A Late Starter	15
Chapter III. Federalism and Technology	21
Chapter IV. Conclusion: Toward a New Science Consumerism	27
Appendices	
A. Committee Charter	31
B. Federal Agency Representatives	33
C. State Liaison Committee	37
D. Federal-State Conferences	41
E. Federal Agency Support of State R&D and Related Activities	42
F. State Government R&D Expenditures and Personnel	44
G. Local Government R&D Expenditures and Personnel	48
H. Science and Technology Resolutions and Recom- mendations: National Legislative Conference, Na- tional Governors Conference, National League of Cities, and State County City Service Center	53
I. "Stronger Federal, State and Local Partnerships," Excerpts, Presidential Message on Science and Technology, March 16, 1972	59

SUMMARY AND RECOMMENDATIONS

SUMMARY

The current shifting of national priorities is leading to major shifts in Federal programs to meet domestic needs. Because alleviation of many of the Nation's problems will require huge expenditures both in terms of human and fiscal resources the Federal Government is devoting considerable funds to research and development. Unlike the massive effort to develop our military and aerospace capabilities, however, this newer application of science and technology is being applied directly to problems which are basically the responsibility of State and local governments. If the Federal investigation of such problems as pollution, rural poverty, traffic jams, housing shortages and urban congestion is to be useful, the ability of State and local governments to apply new solutions involving science and technology is of critical importance. The main thesis of this report is that State and local governments, to a large extent, are not prepared to handle this public technology role, and that the Federal Government is doing far too little to involve those units of government in the formulation of science and technology priorities addressed to domestic needs.

Although State and local governments in the past five years have come a long way in recognizing science and technology as part of their responsibilities and structures, it is still true that outside of a few fields such as highways, agriculture and, to a lesser extent, public health, science and technology application by State and local governments has been and remains extremely limited.

Meanwhile, the Nation has reached a consensus on the desirability of placing greater responsibility on the lower tiers of government in our Federal system. There is, however, ample room for a Federal partnership with State and local governments to grow in the R&D area. The current distribution of domestic R&D spending is about one penny by State and local governments (including Federal grants and assistance) to every dollar by Federal agencies. Yet total expenditures by State and local governments for general domestic programs are about double those of the Federal Government.

Science and technology is generally absent from the policy-making and operations of State and local governments, although virtually all states and a few cities have at least an informal science advisory body or personnel. The Committee considers it essential that State and local governments develop more capacity

to assess and to assimilate scientific and technological knowledge. Development of this capacity is primarily the responsibility of State and local governments. But without Federal assistance it is doubtful that the current limited science-technology input at the State and local level will be expanded.

The Committee is of the view that modest sums invested in State and local government R&D could significantly enhance the utility and effectiveness of the Federal effort to develop solutions to domestic problems. This conclusion is based on the following observations derived from the Committee's extensive contacts with State and local policymakers and science and technology professionals:

1. Much of the present interest of State and local governments in the possible contributions of science and technology to their problems reflects their dissatisfaction with the present Federally dominated system. This attitude derives from a feeling of exclusion from the determination of research priorities and project selection as well as inadequate transfers of information on research performed or sponsored by the Federal Government.
2. Federal policies relating to science and technology shape and condition the environment in which many units of State governments operate in unintended and sometimes undesirable ways. Federal decisions on R&D funding, for example, may influence demands on State budgets for higher education. The multiplicity of Federal programs in health and environmental areas often prevents or impairs the development of coordinated State and local government programs. Federal standards for air pollution place requirements on State or municipal agencies for manpower or expenditures by local industry that can constrain or subtract from economic activity and the tax base.
3. The configuration of public problems is not the same across the Nation, despite the tendency to accept such terms as "the transportation problem" or "the pollution problem." While many of these problems have common characteristics, thereby providing a rationale for a central research focus, these problems and others are also heterogeneous and multifaceted, so that the search for a single solution from a central source inevitably complicates the problem of applicability.
4. State R&D activity provides a vehicle for experimentation that may exceed the immediate capabilities of Federal agencies because of statutory or political restraints. While decentralization of the science and technology effort in-

volves the possibility of some duplication, there is a trade-off with the speed and probability of finding more varied solutions.

5. There is a tendency on the part of Federal agencies to seek long term total solutions. Increasing the role of the states may produce smaller-scale solutions and only incremental savings or efficiency improvements, but the results are likely to come sooner and thereby encourage support for longer term efforts.
6. The establishment of State and, in some instances, local government inhouse R&D capabilities, even on a limited scale, inevitably will be followed by improved relations between those governments and the outside scientific and technological communities and an exposure to innovative thinking currently lacking or voiced only feebly in many jurisdictions.
7. Increasing the ability of State and local governments to understand and interpret proposed Federal standards and requirements involving scientific and technological criteria will produce more challenges to bureaucratic blindspots and arbitrariness. This should increase the chances for effective implementation when the standards and requirements are promulgated.

The development of a more balanced, intergovernmental R&D effort will, of course, greatly increase the need for communication and coordination. The problem is minimal if the end product of R&D is a piece of hardware such as trash compaction or containerization equipment that can readily be incorporated into an ongoing system and therefore can be evaluated for its contribution to the system. More frequently, however, the end product of research is a report, or possibly a demonstration of an entirely new system. (To use an example in solid waste, recycling in place of removal.) The new system or component requires parallel changes in other programs or even the whole governmental organizational approach. Recycling for instance, implies everything from enlisting citizen cooperation to exploring the possibilities for local use of the material, with resultant savings and new economic activity.

Communication by the Federal Government to State and local government tends to receive a low priority in all fields. The Committee feels it must have a significantly higher priority in science and technology. This conclusion is backed up by a sampling of opinions of State and local government officials who overwhelmingly listed the lack of information and the need for better R&D dissemination by the Federal government as a pri-

mary obstacle to greater utilization of science and technology (see Tables I and II, Chapter I).

The Committee believes that what is needed is a set of flexible arrangements that can facilitate the transfer of science and technology among Federal, State and local government units and the people they serve. The critical points to which information should be directed are located at two levels—one policymaking and the other operations. The information gap is now so broad and deep that the first priority, in many fields, is to identify the problems to which science and technology may be able to offer a solution. Aside from a system to detect science and technology needs, mechanisms should also provide for an integrated science and technology information dissemination and delivery system. The missions of Federal agencies dictate a diverse organizational arrangement to carry out their operational missions. But new operational arrangements cutting across jurisdictional lines, such as the Federal-State-local joint funded projects recommended in this report, may have as a side-effect, the improvement of dissemination and delivery performance. As in the Agriculture Extension Service arrangements described in Chapter III, those who disseminate science and technology and are engaged in its delivery need greater acceptance by the research and development community. It is these non-research personnel who most frequently will be in touch with State and local needs and therefore have much to contribute in the establishment of research priorities. Full partnership and commitment between the communicators and the R&D community is essential for effective application of science and technology. Since the payoff from many R&D projects is highly uncertain, and quite possibly negligible in the short run, continuous evaluation and flexible management is equally important to any new Federal science and technology program.

The particular mechanisms or institutional arrangements to carry out a national science and technology program are difficult to perceive in the early stages of policy definition. The Committee's concrete recommendations which follow, therefore, are meant to point a direction rather than constitute a rigid or comprehensive set of proposals. The Committee feels that policymakers should think of science and technology not as just another element in the attack on domestic problems but rather as a catalyst for innovation. By making State and local governments aware and capable of evaluating the potential of science and technology, the Federal government may be able to induce new ways of thinking about the delivery of services at those levels. Even if results are not immediately forthcoming, State and local officials will be given

a new tool to work with and in the process gain the confidence and enthusiasm needed to make the New Federalism work.

RECOMMENDATIONS

The Committee recommends that:

Policy

1. The Federal government seek and incorporate the views of State and local governments in the formulation of those aspects of national science and technology policy related to State and local requirements and problems.
2. Federal agencies seek to identify science and technology applications of their research and development programs which could be useful to State and local governments.
3. The Federal government actively undertake to disseminate to State and local governments the scientific and technological knowledge which it develops related to the needs of these levels of government.
4. National science and technology programs incorporate the following functions:
 - A. Consultation with State and local government representatives in setting research priorities and allocating resources in areas related to State and local requirements and problems.
 - B. Strengthening the capacity of State and local governments to utilize and, where appropriate, to develop their own scientific and technological knowledge.
 - C. Improved mechanisms for the dissemination and use of scientific and technological knowledge at the State and local government level.

Operations

5. The Director, Office of Science and Technology, designate a lead Federal agency to assume the responsibility for implementing the policy recommendations of this report, utilizing policy guidance from the Federal Council for Science and Technology and appropriate representatives of State and local governments.

Identification of Federal R&D of Benefit to State and Local Governments

6. The Federal Council for Science and Technology in extension of the objectives of the Intergovernmental Cooperation Act of

1968, consider establishing a task force which (in cooperation with affected Federal agencies) can explore improved procedures and organizational arrangements for identifying those technology programs and projects which might be of interest to or meet the needs of State and local governments.

7. The task force undertake a comprehensive survey of State and local governments, in cooperation with State and local science and technology councils, agencies or professionals, to determine which problems they feel should receive priority in the application of science and technology to State and local needs. The task force should also assess how the impact of Federal grant-in-aid programs might be improved through requirements that State and local government units will use funds to obtain those services and commodities that embody "best practices" techniques or use of advanced technology. The Committee's preliminary survey efforts could be a starting point for this effort.

Consultation With State and Local Representatives

8. Federal agencies conduct periodic reviews of R&D activity in consultation with State and local governments to determine the need for revisions of Federal programs, or possibilities for prototype testing and applications in areas related to State and local requirements and problems.
9. The Office of Science and Technology in its annual series of Federal agency program reviews request, where appropriate, a showing of measures taken and planned to strengthen agency couplings with State and local governments.

Strengthening the S&T Capacity of State and Local Governments

10. The lead agency encourage and assist State and local governments to establish mechanisms for the development and coordination of science and technology programs. Among possible useful arrangements would be an Office of Science and Technology, science advisory council to the Governor or mayor or an expansion of the activities of a State or city planning board or major department. In addition, State legislators and city councils should be assisted to develop similar staff capabilities or science advisory mechanisms.
11. The task force (see recommendation 6) assess the need for new or modified Federal programs to expand opportunities for State and local government employment of scientists and engineers. Particular attention should be given to the pos-

sibilities of employing displaced aerospace scientists and engineers and recent graduates in positions relevant to their training and experience in State and local governments.

12. The Federal Government:

- A. Search out opportunities for intergovernmental exchange of scientific and technical personnel.
- B. Maintain a scientific and technical manpower clearinghouse for State and local governments.
- C. Support in-service training of State and local program managers to expand their awareness of opportunities for utilizing new scientific and technological developments.
- D. Assist State and local governments under the provisions of the Intergovernmental Personnel Act of 1970 in achieving realistic position classifications and competitive salary structures for quality scientific and technical personnel.

Creation of Mechanisms to Improve Science and Technology Dissemination

- 13. Funds be provided to support joint Federal-State-local public technology research projects with potential for widespread applications in State and local governments. These projects could involve one or more State and local government units with the research performed in-house or contracted out. Consideration should be given to the creation of State-sponsored regional research institutes to provide larger scale efforts and avoid unnecessary duplication of effort.
- 14. New institutional arrangements be created between academic institutions and State and local governments, such as the Urban Observatory Program of HUD and the Office of Education of HEW, to deal with the application of science and technology to State and local problems.
- 15. Federal laboratories be made available, where appropriate, for use by State and local agencies on a reimbursable basis, or in some instances, using specifically identified Federal funds for State and local projects where authorized and appropriate.
- 16. The lead agency in cooperation with the Office of Science and Technology study the benefits and costs of a Federal centralized data bank on science and technology projects, both in government and private industry, and the establishment of an information service to State and local governments.

CHAPTER I

THE INTERGOVERNMENTAL REQUIREMENTS OF A PUBLIC TECHNOLOGY

For nearly a century American industry has been demonstrating the power of science and technology to improve our standard of living and change our style of life. Americans readily support R&D costs of industry even if the improved products cost more.

Government research and development (outside of a few fields such as health, highways and agriculture) did not gain widespread acceptance, however, until after World War II. And then, much of it was sponsored by the Federal government to develop our aerospace and military capacities.

In recent years there has emerged a trend toward the broader application of the R&D process to the solution of domestic problems. This process draws heavily on both science (defined broadly as the study of physical, biological, social and individual behavior using scientific method) and technology (the application of scientific knowledge to the solution of problems or meeting of human needs).

While basic research is an essential part of new Federal endeavors, in the domestic area the main effort must be the development of a "public technology" which is closely related to problems and tailored to the decision-making needs of government. Public technology can be defined as technology which is explicitly responsive to the policy goals and operational requirements of civil governments; it is a "service" technology for the civilian public sector, designed to supply technical alternatives in carrying out governmental roles and missions. In contrast to public technology, private technology is that technology which is accepted or rejected purely by the private market mechanism.

The broadest possible dissemination of public technology is generally agreed to be desirable. Most of the transferable military and space R&D, which accounts for the largest share of Federal R&D expenditures during the past decade, is utilized by the private sector. Although attempts have been made to make transfers of military and space R&D to the public sector, these have had only limited impact. In any event, it is unrealistic to expect that military and space R&D would satisfy a significant portion of the R&D needs of State and local governments.¹ The State and local R&D effort, as yet, has been so small as to produce negligible amounts of public technology (see Chapter II). The product of R&D car-

ried out by such Federal agencies as Commerce, HEW, HUD, Justice, Transportation, NSF, and OEO is designed ultimately for public use. But the practical output has been sparse. Many State and local government officials feel that the effort of a number of agencies is still directed primarily to industry and does not address itself to the right priorities. State and local governments have, of course, been slow to recognize a need to undertake or guide the development of public technology.

To a large extent, many officials are not even aware of the full potential of public technology activities. This should not necessarily be equated with lack of interest. A survey performed for the Committee by the International City Management Association showed that State and local officials overwhelmingly recognize lack of information on science applications as an obstacle and want the Federal government to provide better organized R&D information services to them. (See Tables I and II).

On the other hand, State and local governments, it must be recognized, are not sufficiently aware of or utilizing the scientific and technical resources within their own jurisdictional control, such as colleges and universities. Their public service functions, even in those institutions run with public funds, are usually limited to federally sponsored research.² Yet time after time, State officials have told the Committee that what Governors and legislators need is a source of scientific and technological expertise to which they can turn for quick information or at least a quick start on the investigation of a problem. Unless their particular problem fits in with Federal or foundation research interests, they do not have much chance for obtaining help, and the application process is often slow and tedious. Even where there is Federal interest, a more decentralized R&D effort utilizing State and local resources would be beneficial. It not only could provide "close in" and "near term" solutions but also vastly enrich the Federal effort.

Decentralization necessarily would place the R&D activity closer to the problems, since State and local governments provide the bulk of domestic public services such as police, fire, sanitation, public works, transportation and housing. Anytime a government, or industry for that matter, wants to employ new technology or establish a "sociotechnical system" a key requirement is an interface between the policymaker and the technician. If one tries to introduce new technologies without adjusting the government apparatus to receive it, the result, more often than not, is a sterile, inconsequential change or perhaps a change for the worse. Most successful applications of technology have been preceded by or inextricably woven with patient efforts not only to sell and explain

TABLE I *
OBSTACLES TO OBTAINING SCIENCE-TECHNOLOGY ADVICE

	State Government ¹		Local Government ²	
	Percent Ranking ³ Important	Importance ⁴ Factor	Percent Ranking ³ Important	Importance ⁴ Factor
Inadequate financial resources ⁵			75	91.6
Lack of information exchange mechanism between levels of government regarding scientific advice and application	64	80.0	47	79.7
Legal restrictions	31	49.2	7	70.9
Lack of supply of qualified science and technology advisors	39	71.3	28	71.8
Unwillingness of qualified personnel to serve as advisors	32	49.6	11	59.4
Inability of science and technology advisors to understand complex government decision process	42	64.8	18	64.5
Absence of support from elected officials ⁶			25	69.3
Absence of support from legislators ⁷	47	68.6		
Resistance of departmental personnel	37	51.0	18	63.4

*Surveys by International City Management Association.
(See footnotes on Table II.)

the new technology well in advance but also to garner reaction from officials and the public. The more thorough the preparation, the greater the chance of removing the "bugs" before the new technology is emplaced.

The Federal planner in Washington or a regional office may be aware of the general needs of States and cities. But he cannot fully understand the many geographical and other variations in local problems. Nor can any one person or group of persons, especially within one agency or office of the Federal government, have the operational knowledge of the public servants at the State and local level who struggle to provide the daily needs of the citizens.

It is the recognition of this basic limitation on the National

TABLE II *
**DESIRABLE ASSISTANCE PROGRAMS TO PROMOTE
SCIENCE-TECHNOLOGY APPLICATIONS**

	<i>State Government</i> ¹		<i>Local Government</i> ²	
	<i>Percent Ranking</i> ³ <i>Important</i>	<i>Importance</i> ⁴ <i>Factor</i>	<i>Percent Ranking</i> ³ <i>Important</i>	<i>Importance</i> ⁴ <i>Factor</i>
Federal grants to assist R&D utilization	83	76.6	53	79.2
State grants to assist R&D utilization ⁵			42	67.6
Better organized R&D information services for benefit of State/local government by Federal government ..	80	72.6	47	74.5
Better organized R&D information services for benefit of local government by State government ⁶			37	75.8
Federal grants to provide in-service training opportunities for local administrators ..	69	65.9	37	72.2
Federal grants to provide salary subsidies for scientifically and technically trained manpower	74	67.2	31	69.7
Federal support of undergraduate and graduate education for public service in State and local government	60	48.1	24	67.3

*Surveys by International City Management Association.

¹ Based on replies received from 78 departments of state government.

² Based on replies received from 295 cities with over 25,000 population.

³ Those indicating item to be in first four categories of importance.

⁴ Obtained by assigning 100 to top importance rating, 80 to second, 60 to third and 40 to fourth, and dividing each total by number of responding governments times 100.

⁵ Obstacle taken as a given in state survey, based on the returns from the local government survey which was conducted first.

⁶ Question included only in local survey.

⁷ Question included only in state survey.

government which has led to the acceptance of the idea of a downward distribution of power in our federal system. As President Nixon said in his State of the Union message this year:

"The time has come for a new partnership between the Federal Government and the States and localities—a partnership in which we entrust the States and localities with a larger share of the Nation's responsibilities, and in which we share our Federal revenues with them so that they can meet those responsibilities."

If State and local governments are to be given more responsibility and funds, then it is essential that their capacity to assess and utilize science and technology be increased. One reason is that public technology is required to control the undesired consequences of private technology, as in anti-pollution programs. More important, citizens are no longer taking for granted that events are beyond their control. Those who have comprehended what science and technology can do, such as putting man on the moon, are unlikely to be satisfied much longer with "horse and buggy" service on earth.

The decentralization of the production of public technology would give State and local governments a tool for discerning problems before they have reached the crisis stage. State activity would provide a vehicle for experimentation that might go beyond the immediate capabilities of Federal agencies because of statutory limitations. Creating a greater number of independent research programs runs the risk of some duplication, but a variety of approaches to solutions has often proven more "efficient" than a centrally dominated research strategy.

The Committee feels that State and local governments can be persuaded that public technology investments offer a relatively inexpensive way to upgrade existing public services and offer new ones. R&D requires only modest investment of funds and personnel with potentially large payoffs. What is missing is the capacity to demonstrate this. A few states are giving attention to public technology. Pennsylvania and Virginia, for instance, have even established university-based science policy centers and a number of earlier efforts (primarily oriented toward industrial development) are described in Chapter III. But none of the States and cities which have successfully introduced technology has the resources to disseminate or demonstrate the results for the benefit of other governments that are faced with similar problems.

The need for the Federal government to serve as intermediary is, to the Committee, inescapable. Washington has the resources, it has the expertise, and it has the national communications network. It also has a special responsibility to capitalize on its invest-

ment of billions for R&D in defense and space by using the knowledge gained for the solution of civilian needs. One reminder of this responsibility is the high rate of unemployment amongst scientists and engineers resulting from the cutbacks in aerospace and defense industries, currently running from 50,000 to 65,000 of the estimated 1.7 million in the country. While not all of the unemployed have skills transferable to other sectors, employment opportunities for scientists and engineers could be significantly increased by a determined national effort to expand public technology for civilian needs.

The Committee feels that the best interests of Federal, State and local governments, as well as private industry and the general public, will be more effectively served if the Federal government takes the lead in encouraging State and local governments to enhance their capabilities in the application of scientific and technical knowledge. Such a policy would not only help Federal efforts to solve domestic problems, but would serve other national objectives such as decentralizing governmental responsibilities, expanding the economy, keeping America in the forefront of science and technology and thus in a position to maintain its export capacity. Last, but not least, it would demonstrate that science and technology can be a catalyst for the strengthening of the democratic system.

To carry out such a policy, however, requires a major re-orientation of thinking in Congress and the executive branch. The first requirement is to ensure a proper State and local input in national science and technology policy making and programs. To this end, the Committee recommends that:

1. The Federal government seek and incorporate the views of State and local governments in the formulation of those aspects of national science and technology policy related to State and local requirements and problems.
2. Federal agencies seek to identify science and technology applications of their research and development programs which could be useful to State and local governments.
3. The Federal government actively undertake to disseminate to State and local governments the scientific and technological knowledge which it develops related to the needs of these levels of government.
4. National science and technology programs incorporate the following functions:
 - A. Consultation with State and local government representatives in setting research priorities and allocating resources in areas related to State and local requirements and problems.

- B. Strengthening the capacity of State and local governments to utilize and, where appropriate, to develop their own scientific and technological knowledge.
- C. Improved mechanisms for the dissemination and use of scientific and technological knowledge at the State and local government level.

The next requirement is that the Federal government adopt appropriate mechanisms for carrying out a State and local government-oriented research and development program. To this end, the Committee recommends that:

1. The Director, Office of Science and Technology, designate a lead Federal agency to assume the responsibility for implementing the policy recommendations of this report, utilizing policy guidance from the Federal Council for Science and Technology and appropriate representatives of State and local governments.
2. The Federal Council for Science and Technology in extension of the objectives of the Intergovernmental Cooperation Act of 1968, consider establishing a task force which (in cooperation with affected Federal agencies) can explore improved procedures and organizational arrangements for identifying those technology programs and projects which might be of interest to or meet the needs of State and local governments.
3. The task force undertake a comprehensive survey of State and local governments in cooperation with State and local science and technology councils, agencies or professionals, to determine which problems they feel should receive priority in the application of science and technology to State and local needs. The task force should also assess how the impact of Federal grant-in-aid programs might be improved through requirements that State and local government units will use funds to obtain those services and commodities that embody "best practices" techniques or use of advanced technology. The Committee's preliminary survey efforts could be a starting point for this effort.

FOOTNOTES TO CHAPTER I

¹ This is true of the NASA and AEC Technology Utilization programs, as well as those of the Commerce Department and Small Business Administration. With a few exceptions, all seem primarily directed to assisting private organizations.

² See page 15 and Footnote 2 of Chapter II.

CHAPTER II

STATE AND LOCAL R&D: A LATE STARTER

State and local governments stand, with respect to utilization of science and technology roughly where the Federal government did in 1940—that is, largely dependent on external sources for research and development.

Compared to Federal R&D expenditures of \$17 billion in FY 1968, for instance, State and local governments spent only \$184 million for the same purpose—a ratio of about one penny for every Federal dollar. Furthermore, the distribution of the R&D effort was concentrated in a relatively few states and localities.¹ Most of the effort was directed to a few functional areas (health and hospitals and education representing slightly over 50 percent). The Federal domination of R&D is also evident in public higher education institutions despite the fact that they receive more than twice as much general funding support from State and local government sources as from the Federal Government.²

The low levels of State and local government resources invested in R&D reflect, in part, the lack of public pressure on them for innovation. The United States “had to be first” in space and military power because of the public’s perception of such events as Sputnik I and the threats to national security in the postwar era. It was not until the mid-1960’s, however, that State and local governments suddenly were subjected to the political pressures generated by such phenomena as pollution, riots, rising welfare loads and increased crime. The difficulty was that the response required had to be immediate—hardly conducive to the patient processes recognized as essential to producing a nuclear warhead or space rocket. Furthermore, State and local governments lacked any substantial nucleus of the organizational and professional talent upon which to build a science and technology capability. To some extent, the Federal Government siphoned off the talent and left the States with little more role to play than competing for location of industry and contracts associated with the multi-billion dollar aerospace-military R&D effort. Such R&D capacity as developed within their borders was characterized by extra-territoriality of funding and control.

Unfortunately, much of the new Federal R&D effort which depends on State and local governments as the ultimate consumers of the product is being conceived and managed as if the latter did not exist. This, at least, is the perception of the Federal effort to

date by large numbers of State and local officials, regardless of the intent of authorizing legislation and executive orders. From the Federal viewpoint, there is, of course, a converse perception of a lack of capacity on the part of State and local governments to cooperate in the Federal effort. To some extent Federal R&D continues to pre-empt the growth of similar capacity in the lower tiers of government. This phenomenon is noted only to show the futility of pursuing a "chicken vs. the egg" type discussion. A more fruitful approach to a federalist strategy of science and technology development is to identify those elements of an R&D capacity which are present or absent at the State and local level, along with the obstacles to their further development.

Organizational Structure

Planned State use of science and technology is a little over a decade old. Beginning in 1958, a few of the States took steps to organize centralized science and technology functions at the State level. Most of the early organizations—such as the North Carolina Research Triangle Institute and the New York State Advisory Council for the Advancement of Industrial Research and Development—were established primarily to stimulate economic development and not to provide science and technology advice on a broad front. From these early institutions have evolved a variety of State science and technology organizations in virtually every state.

SUMMARY OF STATE SCIENCE AND TECHNOLOGY ORGANIZATIONS

<i>Type</i>	<i>No. of States (Estimate)</i>
Governors' Science Advisors or Liaison Officials	49
Governors' Science Advisory Committees	19
Science Advisory Committees to State Legislatures	5
Science and Technology Commissions	4
Offices of Science and Technology	6
State Science and Technology Foundations	5

Source: National Science Foundation.

Most of these organizations have been created during the past few years and have not become firmly established or made major contributions to State operations, but they provide strong evidence of the recognition of a role for science and technology in State government. One indication of the growing interest in science applications in the States was the formation in 1970 of the National Governors' Council for Science and Technology comprised

of State science advisors. The picture in local government is spottier. Only six cities (of those responding to a survey)³ have organized technology units. Some of the weaknesses of these State and local science and technology programs are:

1. Lack of cohesive policies and programs essential to promoting continuity of effort.
2. Primary reliance on outside consultants because of lack of qualified scientific staff.
3. Virtual absence of effective information systems to disseminate available scientific information to decision-makers.
4. Except for extension services in agriculture, water resources and public health, there are few linkages between academic institutions and government at the State and local level.

Despite these major obstacles, however, there is some evidence of the science and technology input in State government.⁴

Manpower

As might be expected, the same disparities between the dollar inputs of Federal vs. State and local government R&D are reflected in the employment figures for scientists and engineers.⁵ The employment ratio for scientists and engineers is nearly two to one in favor of the Federal government. Yet State and local government employment in all categories outstrips the Federal government by nearly four to one. The paucity of scientific and technological personnel in most areas of State government is highlighted by the fact that about 90 percent of the engineers and 80 percent of the technicians are employed in highways and public works agencies. Most scientists work in agriculture and conservation or in health and welfare. Furthermore, only 7 percent of the scientific, technical and professional employees of State governments in 1968 were engaged in R&D activities.

There are a number of divergent opinions on the quality of technical staffs in State and local agencies. The Municipal Manpower Commission reported in 1962, for instance, that:

"The quality of APT (administrative, professional technical) personnel in local governments today, by and large, is inadequate to cope with present and especially emerging metropolitan problems. . . ."

The major obstacles to improvement of the situation appear to be:

1. Unfavorable working conditions.
2. Limited budgets for equipment and office space.

3. Limited career development opportunities and programs.
4. Limited job mobility.
5. Except for some large jurisdictions, inadequate in-service training and promotion opportunities.
6. Widespread absence of merit systems.⁷

The Federal government has initiated limited programs designed to help place scientists and engineers put out of work by the recent cutbacks in aerospace and defense activities. These efforts have involved retraining, job location assistance and general job creation programs representing an aggregate expenditure of over \$47 million. In addition, the President in July 1971 signed into law the Emergency Employment Act of 1971 to provide work for 150,000 to 200,000 unemployed persons in public service jobs in State and local governments during fiscal years 1972 and 1973. The Department of Labor was given \$2.25 billion for administering the Act during the 2-year period.

Although employment figures for FY 1972 are currently unavailable, it appears on the basis of Department of Labor estimates, that fewer than 200 to 300 of the estimated 50,000 to 75,000 unemployed scientists and engineers will obtain employment under the Act. Preliminary results under the other various retraining programs mentioned above indicate that few of the retrained scientists and engineers will be able to locate suitable positions in State and local governments.

The reasons for the failure to find employment in State and local government for significant numbers of scientists and engineers are complex, starting with the failure to recognize the importance of a technology capability. At a time when cities are laying off workers or forcing attrition to achieve 10 and 20 percent cutbacks, States are feeling it may be difficult, even with outside assistance, to take on a wholly new class of high-salaried professionals. Then, too, the Emergency Employment Act is aimed primarily at the disadvantaged and veterans. Some of its provisions may actually work to the detriment of hiring scientists and engineers, such as the \$12,000 ceiling on the Federal contribution to the salaries which can be paid to those placed. Some of these factors may be short-run and correctable. The long-term outlook, however, for major utilization of scientific, engineering, and technical personnel is unlikely to improve without a transfer of major R&D responsibilities and resources from the Federal government to the States and cities.

Such a transfer cannot be achieved without first ensuring that the states and cities have qualified manpower. As a congressional study of American federalism pointed out:

"Even the most brilliantly conceived grant-in-aid program will fail to meet its objectives unless there are qualified State and local personnel to carry it out."

A start in assisting efforts to upgrade the quality of State and local manpower has been made under the recently enacted Intergovernmental Personnel Act of 1970. But as yet little attention has been given under this Act to scientific and technical personnel.

For the purposes of strengthening the science and technology capacity of State and local governments, therefore, the Committee recommends that:

1. The lead agency encourage and assist State and local governments to establish mechanisms for the development and coordination of science and technology programs. Among possible useful arrangements would be an Office of Science and Technology, science advisory council to the Governor or mayor or an expansion of the activities of a State or city planning board or major department. In addition, State legislators and city councils should be assisted to develop similar staff capabilities or science advisory mechanisms.
2. The task force (see recommendation 6, page 5) assess the need for new or modified Federal programs to expand opportunities for State and local government employment of scientists and engineers. Particular attention should be given to the possibilities of employing displaced aerospace scientists and engineers and recent graduates in positions relevant to their training and experience in State and local governments.
3. The Federal Government:
 - A. Search out opportunities for intergovernmental exchange of scientific and technical personnel.
 - B. Maintain a scientific and technical manpower clearinghouse for State and local governments.
 - C. Support in-service training of State and local program managers to expand their awareness of opportunities for utilizing new scientific and technological developments.
 - D. Assist State and local governments under the provisions of the Intergovernmental Personnel Act of 1970 in achieving realistic position classifications and competitive salary structures for quality scientific and technical personnel.

FOOTNOTES TO CHAPTER II

¹ State and local governments spent about \$184 million on research and development in Fiscal Year 1968; about 34 percent of that figure represented expenditures by just two states—New York and California. Six states including these two accounted for 61 percent of the 50 state total of \$154.7 million. Of the \$29.4 million spent by local governments, the ten leading ones accounted for \$16.6 million or more than 56 percent. Additional detailed data on State and local R&D expenditures and personnel are set forth in Appendices F and G.

² In 1970, for instance, total support for public higher education amounted to \$15.8 billion of which State and local governments accounted for \$6.3 billion, Federal sources for \$2.4 billion and all other sources for \$6.7 billion. States supplied about \$215 million to their institutions of higher learning for R&D purposes in Fiscal Year 1968; local governments made similar contributions amounting to \$10 million. Total Federal contributions to R&D in both public and private colleges and universities amounted to over \$1.5 billion in the same year.

³ New York, Los Angeles, St. Louis, Peoria, Knoxville and Hilo (Hawaii). See Science-Technology Advice in Local Governments, Urban Data Service, Vol. 2, No. 11, International City Management Association, November 1970.

⁴ A recent unpublished survey (1971, International City Management Association) indicates that in 42 states, 79 of 81 reporting departments employ scientific and technological advice to some degree and 82 percent of these departments make frequent use of such advice. Population size of the state does not seem to make a significant difference in frequency of use.

⁵ Of 1,543,200 in the United States, industry employs 70 percent, academia 13.7 percent, the Federal Government 9.4 percent, and State and local government only 5.6 percent. (The remaining 1.1 percent are in nonprofit organizations.) Additional data on State and local employment of scientists and engineers are set forth in Appendices F and G.

⁶ Similar conclusions were reached by the Committee for Economic Development in their "Modernizing Local Government to Secure a Balanced Federalism" (1966) and "Modernizing State Government to Secure a Balanced Federalism" (1967).

⁷ The Civil Service Commission reports that of the 2 million persons employed in state agencies in 1965, 44.3 percent were covered by some system of "merit personnel administration."

⁸ Senate, Committee on Government Operations, The Federal System as Seen by Federal Aid Officials: Results of a Questionnaire Dealing with Intergovernmental Relations, 1965, 89th Congress, 1st Session (1965).

CHAPTER III

FEDERALISM AND TECHNOLOGY

Technology "transfer" (whether it be country to county, Federal to State, or industry to industry) is much more complex than the mere transporting of an ideal solution or piece of hardware from one place to another. The disappointments of private and governmental technology transfer attempts¹ provide some painful lessons. They need not generate undue pessimism, however, if future efforts avoid some of the mistakes of the past and have clearly defined, manageable objectives.

It is instructive to look at one example of a Federal technology transfer program in a specific field that has proven record of achievement, State and local involvement, and political durability: the Agriculture Department's Extension Service, Cooperative State Research Service, and land-grant university system. In this system, the functions of identifying problems, planning research and development, evaluating new knowledge, and disseminating and applying it in the field are well integrated. A key element in the success of the extension service, for instance, is an effective local-Federal feedback mechanism. The agents live in a community, know its people and are directly concerned with its problems. They are effective communicators on problems requiring technical know-how. They become aware of the concerns of the farmer, related businesses and community leaders, and thus can give meaningful direction to new research or modification of existing techniques. A two-way flow of information is, thus, an integral part of the Department's operations. It is given direction by the Agricultural Research Policy Advisory Committee. This group facilitates a continuous, overall evaluation and coordination of department R&D activities. In addition, it develops support for a unified and long range agricultural research program and delineates appropriate areas of responsibility between Federal and State agencies.²

The Department has other institutional arrangements to ensure "relevance" in its research. Advisory committees, including State, Federal and sometimes local representation, serve each USDA research program: The State Agricultural Experiment Station, the Agricultural Research Service (ARS), the Forest Service and the Economic Research Service programs, all of which conduct their programs through more than 400 research locations throughout the country. The physical location of many of the Federal ARS stations on campuses of public institutions of higher education provide a direct link with the States.

Of the land-grant college and university system, Representative John W. Davis, Chairman of the Science, Research and Development subcommittee of the House Science and Astronautics Committee, has said:

"The Morrill Act succeeded because it developed responsibility at the State level and then supported it with hard cash."³

What emerges from both the successes and failures of past Federal technology transfer efforts is a fundamental principle:

TECHNOLOGY CANNOT BE FORCE FED; THE DEMAND FOR IT MUST BE CREATED AND NURTURED.

Once this basic principle is accepted, the criteria for a successful Federal technology transfer program falls into place. In the various discussions and workshops held by the Committee, many lists of criteria emerged. But that of the Section N workshop at the Eastern Regional Conference on Application of Science and Technology to Public Programs⁴ is illustrative:

1. Much technology now exists; the problem is how to apply it.
2. In order to create or adapt institutions to apply technology, political leadership must be convinced that technology will serve their political needs.
3. Technology must address the needs of populations.
4. These needs must be communicated to the R&D community at the State and local level through politicians and the R&D community should try to sensitize itself to these needs.
5. The choice of whether to work through existing agencies of government or to create new ones should be decided on a case-to-case basis.
6. Governmental institutions must promote market aggregation or the pooling of sufficient demand to assure a market for new products or systems generated by technology.
7. Elected officials and political administrators should be given training programs which demonstrate how to use R&D in ways which will maximize its political benefits and minimize the political costs and risks.
8. The Federal government should provide a regular flow of funds to State and local governments to conduct research and build institutional linkages which allow the research results to be utilized effectively.

It is somewhat discouraging to find these points being ignored or given but grudging deference in some of the newer Federal R&D activities aimed at the solution of domestic problems. This is not to say that some State and local government involvement is not recognized as essential.⁵ But the implementation of this objec-

tive, as conceived by both legislators and administrators is usually of the "force-feed" rather than "cultivate-nurture" variety.

By requiring recipients of Federal grants or assistance to meet eligibility requirements, to follow program procedures, to draw up plans and planning mechanisms, etc., these programs direct State and local decisions and organizations into courses of action considered desirable by the Federal government. The continuity of this historical approach of the Federal government to State and local problems is illustrated in recent legislation regulating the application of science and technology to air pollution control (Clean Air Act Amendments of 1966) and to water quality (Water Quality Act of 1965 as amended). Similar Federal initiatives which place multiple requirements on State and local governments without adequately consulting them beforehand are constantly under consideration and emerging. The Federal government must, of course, provide policy guidelines and a measure of control over how Federal funds are spent. But the procedures chosen too often erect barriers between R&D planning and application. With the exception of agriculture, highways, and to a certain extent public health, the institutional mechanisms for bridging this barrier are weak. The planning requirements attached to Federal assistance are potentially useful mechanisms. But when this function is performed just to get money—often hastily and without the required diversity of administrative, professional and financial inputs—it takes on the character of game theory, or it becomes carbon copy of what has been proven acceptable in Washington before rather than what is tailored to the needs of the individual state now. Other means of achieving some input by State and local governments in Federal programs are:

1. Informal arrangements for contacts with professional groups of government representatives.⁶
2. National advisory committees on R&D such as HEW's network of 409 committees of which 169 have State and local representatives.
3. Regional offices through which representatives of various Federal agencies may maintain close contacts with State and local agencies.⁷
4. National conferences, committees or task forces sponsored by Federal agencies.⁸
5. Publication services.

Most of these mechanisms do not provide sufficient input from State and local governments for ensuring in-depth consideration of State and local views. Even in their function as top-down communicators of Federal policy and practices, some of them perform

poorly. Dealings with the regional offices, for example, some State and local officials feel, tend to be overly time-consuming and confusing. Local needs and problems are not being adequately or accurately communicated to the Federal program managers in Washington, they believe.

A further problem with the existing array of formal and informal Federal mechanisms is that there is no provision for effectively coordinating or linking related science and technology programs in different areas. This would appear to be a major weakness in view of the new public consciousness of the need to measure the overall impact of new technology on the physical and social environment. Some progress is being made toward inter-agency and inter-program coordination in the Model Cities Program and the Regional Councils of the top federal regional officers of the major domestic agencies.

The basic need remains, however, for more effective consultation mechanisms to ensure that research and development objectives and priorities of State and local governments are reflected in Federal public technology programs.

To this end, the Committee recommends that:

1. Federal agencies conduct periodic reviews of R&D activity in consultation with State and local governments to determine the need for revisions of Federal programs, or possibilities for prototype testing and applications in areas related to State and local requirements and problems.
2. The Office of Science and Technology in its annual series of Federal agency program reviews request, where appropriate, a showing of measures taken and planned to strengthen agency couplings with State and local governments.

Improved consultation, however, will not be enough to achieve a true "federalist" public technology. This will require more linkages of institutional resources, both public and private, at all levels of government. To this end, the Committee recommends that:

1. Funds be provided to support joint Federal-State-local public technology research projects with potential for widespread application in State and local governments. These projects could involve one or more State and local government units with the research performed in-house or contracted out. Consideration should be given to the creation of state-sponsored regional research institutes to provide larger scale efforts and less unnecessary duplication of effort.
2. New institutional arrangements be created between aca-

demic institutions and State and local governments, such as the Urban Observatory Program of HUD and the Office of Education of HEW, to deal with the application of science and technology to State and local problems.

3. Federal laboratories be made available, where appropriate, for use by State and local agencies on a reimbursable basis, or in some instances, using specifically identified Federal funds for State and local projects where authorized and appropriate.
4. The lead agency in cooperation with the Office of Science and Technology study the benefits and costs of a Federal centralized data bank on science and technology projects, both in government and private industry, and the establishment of an information service to State and local governments.

FOOTNOTES TO CHAPTER III

¹ An example, was the attempt, through the State Technical Services Act of 1965, to establish an industrial extension service to help small industries apply science and technology. It was meant to emulate the successful Agricultural Extension Service. President Johnson said at the outset of the program: "If we had had this legislation 25 or 30 years ago, we might have prevented the economic depression that today exists in Appalachia." After its appropriations had reached a four-year total of \$20.8 million by Fiscal Year 1969, STS was refused further appropriations by Congress in December 1969 because of alleged operational and policy weakness and lack of support on the Hill. The early attempts by private industry to sell digital traffic control systems provides another example. Performance was low, costs skyrocketed, a number of firms went broke and New York City was abandoned with an unfulfilled contract (See "The Struggle to Bring Technology to Cities," The Urban Institute, pp. 41-48).

² The committee is co-chaired by the Director of Science and Education at USDA and a Land-Grant University president who represents the National Association of State Universities and Land-Grant Colleges. The membership is equally divided between representatives of State and Federal agencies and has two ongoing work subcommittees and numerous *ad hoc* committees to deal with specific problems.

³ Speech at the National Science Conference, Oct. 12-14, 1970, Atlanta. Published in the proceedings by the Georgia Science and Technology Commission, "Science for Society," pp. 161-3.

⁴ April 2-3, 1970, Massachusetts Institute of Technology. Section N was entitled: "New Structures for Federal, State and Local Government Cooperation," published in *Proceedings of the Eastern Regional Conference on Science and Technology: The Application of Science and Technology to Public Programs* (August, 1971).

⁵ As evidenced by the flow of Federal funds to State R&D programs in an increasing variety of fields outside the traditional ones of agriculture, high-

ways and public health. For a breakdown of these transfers by Federal Department and program see Appendix E.

⁶ Among these groups are the National League of Cities/U.S. Conference of Mayors, Council of State Governments, National Association of Counties, National Governors Conference, International City Management Association and the professional associations of highway and traffic engineers, public works and planning officials.

⁷ The intensity and effectiveness of these contacts vary from agency to agency. Some Federal agencies have yet to decentralize administration of their programs to regional offices. HUD has recently established a program planning and technology staff in the immediate office of each regional administrator which evaluates and projects the financial and physical needs of localities for various types of HUD program assistance, research on urban problems, and carrying out or coordinating special studies on HUD program delivery, relationships with State and local government, etc. Another example of consumer-oriented staff work in regional offices is that conducted by HEW's Social and Rehabilitation Service which stresses activities designed to improve the organization and delivery of services to various target disadvantaged groups. State and local government agencies provide the chief channel for delivery of such services. Ongoing R&D is tested and evaluated in the field through various innovative delivery systems.

⁸ Examples are the National Conference on Weights and Measures and the National Conference of States on Building Codes sponsored by the National Bureau of Standards.

CHAPTER IV

CONCLUSION

"Toward a New Science Consumerism"

During the 1950's and 1960's, a major increase was made in the national investment in science and technology. Government was being asked what it could do for science and technology. Now the question is reversed: "What can science and technology do for government (i.e. meeting the needs of the people)?"

To ask this question is to establish the requirement for public management of technology. The Federal Government has recognized this management role and has attempted to derive some domestic applications from its investment in aerospace and defense research. This effort has not been sufficient, however. Domestic problems have multiplied along with public pressures for solutions. The shortage of solutions is more acute than the shortage of funds, in most instances. This is particularly true in such complex fields as housing, transportation, environmental control and economic development.

Scientists, working by themselves, cannot provide ready answers to such problems. In the proper environment, however, science can be the yeast which causes the conceptual expansion required to break out of existing modes of thinking about public problems. The scientific community, by and large, now recognizes that ivory tower research is not enough to maintain public support for science. There is, however, but a primitive degree of understanding in government of the need to create a proper environment for the growth of public technology. An essential ingredient of such an environment, the Committee feels, is for scientists to work in as close proximity as possible to the problems and political processes for solving them.

State and local governments, despite their current limitations, are an ideal environment for developing and testing science applications. First of all, they account for two-thirds of the national expenditures on domestic programs. As the prime consumers, therefore, of new hardware and methods, they obviously will be more receptive to proposed applications if they have a major role in developing them. Secondly and equally important, they are closer to the problems than the Federal Government. This means they can provide a more realistic working environment in which scientists and engineers can interact at close range with both policy and operational personnel. The latter will impose more

restraints on their work, no doubt. But the solutions which result may be more readily applicable.

Without some outside stimulus, however, States, cities and counties are unlikely to create the coordinated institutional mechanisms required to minimize duplication of effort and to make the benefits of separate research and experimental work available to other jurisdictions. If the capacity of State and local government to produce and evaluate scientific knowledge is indispensable to the solution of national problems, then a Federal investment in that capacity is justified. The Federal seeding of this State and local science capacity, however, must be carefully planned and coordinated. The Committee thus places great emphasis on the need for a central or lead Federal agency to attend to the interests of State and local governments in the development of public technology.

Much time and patience will be required to develop an adequate dissemination and feedback system between the Federal and State and local government. The payoffs are uncertain, particularly if managers of public technology create expectations of quick solutions to long-standing problems. But there may be one immediate benefit: a new sense of confidence in government and technology which will allow the time required to apply that which is known to that which is needed.

APPENDICES

- A. Committee Charter
- B. Committee Membership and Chairmen of Federal Delegations
- C. State Liaison Committee
- D. Federal-State Conferences
- E. Federal Support of State R&D and Related Activities
- F. State Government R&D Expenditures and Personnel
- G. Local Government R&D Expenditures and Personnel
- H. Science and Technology Resolutions and Recommendations: National Legislative Conference, National Governors Conference, National League of Cities, and State County City Service Center.
- I. "Stronger Federal, State and Local Partnerships," Excerpt, Presidential Message on Science and Technology, March 16, 1972.

APPENDIX A

CHARTER OF THE COMMITTEE ON INTERGOVERNMENTAL SCIENCE RELATIONS

Justification

The objectives of the Ad Hoc Committee on Intergovernmental Science Relations of FCST stem directly from the organic charter of the Federal Council for Science and Technology (Executive Order 10807) wherein it is specifically stated that the Council shall consider "the effects of Federal research and development policies and programs on non-Federal programs and institutions . . ." and ". . . the effects of non-Federal programs in science and technology upon Federal research and development policies and programs . . ." Establishment of this Committee is particularly timely (a) because of current Federal initiatives to upgrade the program operations of State and local governments through block grants, consolidation and simplification of requirements of Federal grants-in-aid, and consideration of Federal tax rebates to State and local governments, all of which may require a consonant upgrading of their scientific capabilities; and (b) because many State and local governments across the Nation are currently striving, with varying degrees of success, to develop scientific management and advisory organizations to serve the public interest.

Membership

The Ad Hoc Committee on Intergovernmental Science Relations shall be composed of representatives from the Departments of Agriculture, Commerce, Defense, HEW, HUD, Interior, Justice, Labor, and Transportation; Advisory Commission on Intergovernmental Relations, Atomic Energy Commission, Office of Management and Budget, Federal Power Commission, National Aeronautics and Space Administration, National Science Foundation, Office of Economic Opportunity, Office of Intergovernmental Relations, Smithsonian Institution, and Small Business Administration.

Objectives

The objectives of this Ad Hoc Committee shall be:

- to develop an inventory of Federal objectives and programs that directly or indirectly relate to the scientific and technological activities conducted by State and local governments,

and to appraise the impacts of such Federal programs on State and local governments;

- to inventory and describe existing scientific and technological objectives, programs, policies and management operations of State and local governments, and to appraise the relation of these to Federal programs;
- to identify the need for scientific resources, including manpower and institutional requirements, of State and local governments, and to assess the adequacy and impact of Federal programs bearing on these needs for the purpose of identifying areas or activities requiring additional emphasis;
- to recommend policies, procedures and programs to improve management, information exchange, and planning coordination of Federal agency activities with related activities of State and local governments; and
- to formulate in consultation with representatives of State and local governments intergovernmental policies regarding Federal-State-local government cooperation in science and technology, including recommendations for new Federal initiatives to strengthen the scientific and technological activities of State and local governments.

APPENDIX B

COMMITTEE ON INTERGOVERNMENTAL SCIENCE RELATIONS

Agency Representatives

ADVISORY COMMISSION ON INTER-
GOVERNMENTAL RELATIONS Mr. Elton K. McQuery
Assistant Director

ATOMIC ENERGY COMMISSION Dr. James Coleman
Technical Advisor to the Assistant
General Manager for Research and
Development
Mr. Enzi DeRenzis
Assistant to the Assistant General
Manager for Development

DEPARTMENT OF AGRICULTURE .. Dr. Roy Lovvorn
Administrator
Cooperative State Research Service
Dr. N. P. Ralston
Associate Director
Science and Education

DEPARTMENT OF COMMERCE *Dr. Myron Tribus
Assistant Secretary for Science and
Technology
Mr. Walter A. Hahn
Director of Policy Analysis
Mr. Ralph Sullivan
Special Assistant for Technology
Transfer
Mr. William Ellis
Special Assistant to the Assistant
Secretary for Science and Tech-
nology
Dr. Jack Shuman
Technical Information Specialist

DEPARTMENT OF DEFENSE Mr. Edward Glass
Assistant Director (Lab Manage-
ment)
Office of the Director of Defense
Research and Engineering
Mr. Rodney Nichols
Special Assistant to the Deputy Di-
rector (Research and Advanced
Technology)
Dr. Gilford G. Quarles
Chief Scientific Advisor
Office of the Chief of Engineers
Department of the Army

DEPARTMENT OF HEALTH,

EDUCATION, AND WELFARE

*Dr. Lewis H. Butler

Assistant Secretary for Planning and
Evaluation

*Dr. James E. Allen, Jr.

Assistant Secretary and Commis-
sioner of Education

Mr. Charles C. Johnson, Jr.

Administrator

Consumer Protection and Environ-
mental Health Service

Dr. Richard E. Marland

Assistant Commissioner for Program
Development

Environmental Control Administra-
tion

Consumer Protection and Environ-
mental Health Service

Dr. Wilson Talley

Special Assistant to the Secretary
White House Fellows Program

DEPARTMENT OF HOUSING AND

URBAN DEVELOPMENT

*Mr. Harold B. Finger

Assistant Secretary for Research and
Technology

Mr. Alan R. Siegel

Director, Environmental Factors and
Public Utilities Division

DEPARTMENT OF INTERIOR

*Dr. Donald D. Dunlop

Science Advisor to the Secretary

Dr. William Thurston

Special Assistant to the Director

U.S. Geological Survey

DEPARTMENT OF JUSTICE

Dr. Irving Slott

Acting Director

National Institute of Law Enforce-
ment and Criminal Justice

DEPARTMENT OF LABOR

Miss Lily Mary David

Chief

Division of Wage and Labor Stand-
ards

Office of Policy Development

DEPARTMENT OF TRANSPORTA-

TION

*Dr. Robert Cannon

Assistant Secretary for Advanced
Systems Development Technology

	Dr. G. W. Clevon Associate Administrator for Research and Development Federal Highway Administration
FEDERAL POWER COMMISSION	*Commissioner Carl E. Bagge *Commissioner Albert B. Brooke Mr. James J. Stout Chief Division of River Basins
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	*General Jacob E. Smart Assistant Administrator for DOD and Interagency Affairs Mr. Melvin S. Day Acting Assistant Administrator for Technology Utilization Mr. Ronald Phillips Director Technology Utilization Division
NATIONAL SCIENCE FOUNDATION	*Dr. W. D. McElroy Director Dr. M. Frank Hersman Head Office of Intergovernmental Science Programs Miss Dolores Gregory Office of International Programs
OFFICE OF ECONOMIC OPPORTUNITY	Dr. John O. Wilson Assistant Director for Planning Re- search and Evaluation Mr. Robert C. Crawford Program Officer Division of State and Local Govern- ment Office of Operations
OFFICE OF INTERGOVERNMENTAL RELATIONS	Mr. Robert P. James Assistant Director
OFFICE OF MANAGEMENT AND BUDGET	Mr. Thomas Graves Special Assistant for Intergovern- mental Relations Organization and Management Sys- tems Division Mr. Hugh F. Loweth Assistant Chief (General Science) Economic Science and Technology Division

OFFICE OF SCIENCE AND
TECHNOLOGY

*Dr. Lee DuBridge
Science Advisor to the President, and
Director, Office of Science and Tech-
nology

Mr. Eric B. Ward
Executive Officer
Federal Council for Science and
Technology

SMALL BUSINESS

ADMINISTRATION

Dr. Richard Hellmann
Director
Economic Planning and Research

Mr. Andrew A. Canellas
Acting Chief
Economic Planning Group
Office of Planning Research and
Analysis

SMITHSONIAN INSTITUTION

Dr. Sidney R. Galler
Assistant Secretary for Science

Dr. David Challinor
Deputy Assistant Secretary for Sci-
ence

Dr. I. E. Wallen
Director
Office of Environmental Science

* Head of Federal delegation for State Visits.

APPENDIX C

STATE LIAISON COMMITTEE

State Representatives

CALIFORNIA	Mr. Albert J. Lipson Director Office of Research California Assembly Mr. Frederick Styles Executive Secretary Science and Technology Council California Assembly
CONNECTICUT	Dr. John Burlew Director Connecticut Research Commission
GEORGIA	Dr. John E. Mock Director Georgia Science and Technology Commission
ILLINOIS	Dr. Boyd R. Keenan Governor's Science Policy Advisor Dr. James B. Holderman Governor's Science Advisor
KANSAS	Dr. C. E. Barthel Director Kansas Research Foundation
LOUISIANA	Mr. Donald J. Whittinghill Executive Director Louisiana Board of Nuclear Energy
MASSACHUSETTS	Dean Martin W. Essigmann Chairman Governor's Advisory Committee on Science and Technology Mr. David L. Turner Science and Technology Representa- tive Massachusetts Department of Com- merce and Development Dr. Jack Kyger Director Massachusetts Science and Tech- nology Foundation
MISSISSIPPI	Dr. Kenneth C. Wagner Director Mississippi R&D Center

	Mr. Byron Long Special Projects Manager Mississippi R&D Center
	Mr. Tom E. Flynn Chief of Contract Management Branch Mississippi Test Facility
MISSOURI	Dr. Daniel S. Eppelsheimer Governor's Science Advisor
NEW YORK	Dr. William E. Seymour Deputy Commissioner for Industrial Science and Technology New York State Department of Com- merce
	Mr. Robert D. Vessels Nuclear Power Specialist Department of Public Services
NORTH CAROLINA	Mr. Peter J. Chenery Director North Carolina Board of Science and Technology
OKLAHOMA	Mr. Garland Hadley Executive Director Frontiers of Science Foundation of Oklahoma
PENNSYLVANIA	Dr. Thomas E. Fox Governor's Science Advisor
	Mr. Robert E. Hansen Director Office of Science and Technology Department of Commerce
	Dr. Irwin Feller Director Center for the Study of Science Policy Pennsylvania State University
TENNESSEE	Dr. A. B. Biscoe, Jr. Assistant Vice President for Institu- tional Research University of Tennessee
ROCKY MOUNTAIN STATES FEDERATION	Governor Jack Campbell President Federation of Rocky Mountain States
	Dr. Donald W. Galvin Vice President Federation of Rocky Mountain States

Associations Representatives

AMERICAN SOCIETY FOR PUBLIC ADMINISTRATION	Mr. John Garvey
CITIZENS CONFERENCE ON STATE LEGISLATURES	Mr. Larry Margolis Mr. William Colman
THE CONFERENCE BOARD	Mr. John Murphy
COUNCIL OF STATE GOVERNMENTS SCIENCE AND TECHNOLOGY PROJECT ..	Mr. William D. Carey Dr. Clarence Danhof Dr. George A. Bell
INTERNATIONAL CITY MANAGEMENT ASSOCIATION	Mr. Mark Keane
NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND GRANT COLLEGES	Dr. Christian Arnold Dr. George Strother Dr. C. Brice Ratchford
NATIONAL GOVERNORS' COUNCIL FOR SCIENCE AND TECHNOLOGY	Dr. John E. Mock Dr. Thomas G. Fox
NATIONAL LEGISLATIVE CONFERENCE ..	Honorable Thomas Anderson Mr. Edward Crane
PUBLIC TECHNOLOGY, INC.	Mr. Porter Homer

APPENDIX D

FEDERAL-STATE CONFERENCES

State Conferences

CALIFORNIA February 2, 1970	Environmental Quality: Goals and Roles of Government
CONNECTICUT December 11, 1969	Urban Science and Technology
GEORGIA November 13, 1969	Federal-State Partnership in Science and Technology
ILLINOIS January 27, 1970	New and Changing Educational Institutions for the Seventies: Patterns for Intergovernmental Scientific Cooperation
LOUISIANA-MISSISSIPPI March 17-18, 1970	Applications of Science and Technology to Coastal Development
MASSACHUSETTS February 10, 1970	Applications of Science and Technology to the Needs of Massachusetts: Current and Future Perspectives and Enhancement of Intergovernmental Cooperation in Science and Technology
MISSOURI February 18, 1970	Federal-State Cooperation in Rural Development
NEW YORK March 5, 1970	The Environment: Conservation vs Economic Progress
OKLAHOMA March 16, 1970	Applications of Science and Technology to State Government
PENNSYLVANIA December 14, 1969	The New Federalism: Strategy for Science and Technology in the 70's
ROCKY MOUNTAIN STATES* February 3, 1970	Regional Application of Science and Technology

Regional and National Conferences

BOSTON, MASSACHUSETTS April 2-3, 1970	Eastern Regional Conference: The Application of Science and Technology to Public Programs
SALT LAKE CITY, UTAH March 9-11, 1970	Western Conference: Science and Technology and its Application to the Problems of Pollution, Transportation and Employment
CHICAGO, ILLINOIS November 17-19, 1970	Midwest Regional Conference: Science, Technology and State Government
ATLANTA, GEORGIA October 12-14, 1970	National Conference: Goals, Policies and Programs of Federal, State and Local Science Agencies

* Colorado, Idaho, Montana, New Mexico, Utah and Wyoming

APPENDIX E

FEDERAL SUPPORT of STATE R&D AND RELATED ACTIVITIES

Federal Department ¹ R&D Programs	R&D Funds Directly to State and Local Governments		
	FY 1968	FY 1969	FY 1970
1. HUD (Office of Research and Technology) TOTAL	\$ 927,916	\$ 1,326,094	\$ 1,849,791
2. DOT a. Federal Highway Administration (FHWA) ² b. National Highway Safety Bureau	1,780,490	3,791,196	25,000,000 2,600,481
c. Urban Mass Transportation Administration	*	12,100,000	8,500,000
TOTAL	\$ 1,780,490	\$ 15,891,196	\$ 36,100,481
3. National Science Foundation TOTAL	\$ —	\$ —	\$ 96,500
4. Department of Agriculture a. State Agricultural Experiment Stations	7,328,000	5,262,000	4,520,000
b. Extension Service	77,837,000	80,713,000	112,731,000
c. Cooperative State Research Service	55,490,000	58,396,000	60,127,000
TOTAL	\$140,655,000	\$144,371,000	\$177,378,000
5. Department of Health, Education and Welfare a. Environmental Health Service	171,885	886,660	819,858
b. Office of Education	3,778,557	5,169,426	2,534,756
c. Health Services and Mental Health Administration	1,912,906	2,913,810	291,270
d. National Institutes of Health ..	16,232,287	18,509,289	18,110,454
e. Social and Rehabilitation Service	7,391,929	8,204,898	9,188,233
f. Food and Drug Administration	—	103,889	1,804,137
TOTAL	\$ 29,487,564	\$ 35,787,972	\$ 32,748,708
6. Department of Justice National Institute of Law Enforcement and Criminal Justice TOTAL	\$ —	\$ —	\$ 1,484,000
7. Department of Commerce a. Office of State Technical Services	5,830,000	4,874,000	—
b. State Marine Schools	400,000	400,000	400,000

**FEDERAL SUPPORT
of
STATE R&D AND RELATED ACTIVITIES—CON.**

<i>Federal Departments¹ R&D Programs</i>	<i>R&D Funds Directly to State and Local Governments</i>		
	<i>FY 1968</i>	<i>FY 1969</i>	<i>FY 1970</i>
c. National Bureau of Standards	400,000	400,000	200,000
d. Economic Development Admin. Technical Assistance and Re- search (Regions, Areas, and Districts) ²	25,512,000	24,475,000	28,338,000
e. Regional Action Planning Commissions Demonstrations and Technical Assistance	1,627,000	3,512,000	4,383,000
TOTAL	\$ 33,769,000	\$ 33,661,000	\$ 33,321,000
8. Office of Economic Opportunity			
a. Planning, Research and Evalu- ation			2,450,000
b. Health Affairs			2,490,000
c. Program Development			8,400,000
TOTAL	\$ ———	\$ ———	\$ 13,340,000
GRAND TOTAL	\$206,619,970	\$231,037,262	\$296,318,480

¹ Of the agencies listed in the table FHWA, and the HEW and USDA programs have formal R&D programs managed in association with State and local governments.

² Highway planning and research funds apportioned to the states in accordance with Section 307(c), Research and Planning, Title 23, U.S. Code account for the largest portion of FHWA R&D activity, averaging approximately \$25 million annually.

³ The EDA and Regional funds cover technical assistance and research supporting economic development programs and conform with a broad definition of "science and technology."

* Information not available.

Source: Committee on Intergovernmental Science Relations.

APPENDIX F

STATE AGENCY EXPENDITURES FOR RESEARCH AND DEVELOPMENT, BY STATE AND FUNCTIONAL AREA, FISCAL YEAR 1968 (Thousands of dollars)

State	Total	Health and hospitals	Natural resources other than agriculture	Highways	Education, other than institutions of higher education	Agriculture	Police protection and correction	Financial administration and general control	Public welfare	All other
TOTAL	\$154,724	\$66,570	\$38,978	\$20,400	\$15,631	\$2,994	\$2,653	\$2,477	\$1,904	\$3,117
Alabama	366	—	80	286	—	—	—	—	—	—
Alaska	2,423	3	2,194	103	—	—	—	—	82	41
Arizona	425	—	233	192	—	—	—	—	—	—
Arkansas	835	361	139	146	190	—	—	—	—	—
California	28,536	12,897	10,031	2,759	431	48	1,469	11	674	216
Colorado	1,025	495	343	96	—	—	49	—	1	41
Connecticut	1,797	741	370	120	5	—	82	427	12	40
Delaware	84	35	49	—	—	—	—	—	12	—
Florida	3,190	1,189	1,627	362	—	—	—	—	12	—
Georgia	1,677	—	1,222	366	25	20	—	—	44	—
Hawaii	1,667	198	267	16	1,033	152	—	—	—	—
Idaho	812	430	321	7	—	54	—	—	—	—
Illinois	8,756	4,364	3,163	1,020	100	—	—	109	—	—
Indiana	1,290	121	247	870	—	—	—	29	—	23
Iowa	1,667	1,031	177	290	—	150	—	19	—	—
Kansas	1,278	41	146	243	500	20	—	205	123	—
Kentucky	2,536	106	836	426	—	—	—	500	—	669
Louisiana	1,302	452	30	578	241	—	—	—	—	1
Maine	706	—	580	101	21	—	—	—	5	—
Maryland	1,143	316	442	95	271	—	—	19	—	—
Massachusetts	1,635	347	443	355	330	—	26	93	40	—
Michigan	3,369	905	962	877	291	—	240	—	62	33

Minnesota	2,358	203	797	343	513	90	59	133	60	161
Mississippi	837	23	415	399	—	—	—	—	—	—
Missouri	1,751	269	606	214	—	—	—	—	662	—
Montana	1,106	—	1,072	3	—	31	—	—	—	—
Nebraska	359	—	109	134	—	39	—	—	2	75
Nevada	82	—	56	26	—	—	—	—	—	—
New Hampshire	268	145	113	10	—	—	—	—	—	—
New Jersey	3,079	1,863	388	196	503	—	69	48	—	12
New Mexico	659	—	626	33	—	—	—	—	—	—
New York	36,631	31,484	394	2,182	1,410	—	202	144	—	816
North Carolina	7,221	720	336	241	4,728	965	—	78	—	154
North Dakota	290	3	246	31	—	—	—	10	—	—
Ohio	2,789	920	266	1,593	—	—	—	11	—	—
Oklahoma	1,840	876	325	346	5	—	245	1	—	42
Oregon	1,290	—	1,173	25	36	42	5	10	—	—
Pennsylvania	6,802	2,092	1,808	988	324	507	18	244	124	697
Rhode Island	880	250	540	90	—	—	—	—	—	—
South Carolina	566	319	63	84	75	—	—	20	—	5
South Dakota	511	—	268	239	—	—	3	—	—	—
Tennessee	366	107	184	75	—	—	—	—	—	—
Texas	6,644	1,833	207	2,217	2,186	200	—	—	—	—
Utah	1,985	—	261	31	1,353	—	11	330	—	—
Vermont	545	136	177	35	197	—	—	—	—	—
Virginia	2,655	25	1,394	708	119	326	—	—	—	83
Washington	3,222	353	1,628	505	183	350	176	17	—	11
West Virginia	687	—	416	219	53	—	—	—	—	—
Wisconsin	2,387	920	996	7	447	—	—	17	—	—
Wyoming	398	—	217	118	63	—	—	—	—	—

Source: Research and Development in State Government Agencies, Fiscal Years 1967 and 1968, NSF 70-22.

**FULL-TIME-EQUIVALENT NUMBER OF SCIENTISTS AND ENGINEERS ENGAGED IN RESEARCH AND DEVELOPMENT
IN STATE AGENCIES, BY STATE AND FUNCTIONAL AREA, FISCAL YEAR 1968**

State	Total	Health and hospitals	Natural resources other than agriculture	Highways	Education, other than institutions of higher education	Agric- ulture	Police protection and correction	Financial administra- tion and general control	Public welfare	All other
TOTAL	3,733.2	1,376.9	1,287.6	387.0	368.9	37.5	84.7	65.9	54.5	70.2
Alabama	18.0	—	5.4	12.6	—	—	—	—	—	—
Alaska	101.5	0.2	95.8	1.1	—	—	—	—	4.0	0.4
Arizona	20.0	—	15.0	5.0	—	—	—	—	—	—
Arkansas	31.6	14.5	7.6	—	9.5	—	—	—	—	—
California	516.3	281.3	107.3	23.0	15.5	2.0	59.2	1.1	23.2	3.7
Colorado	44.5	15.1	23.0	2.7	—	—	2.0	—	—	1.7
Connecticut	24.7	9.0	3.0	1.4	—	—	1.0	10.2	0.1	—
Delaware	1.4	1.4	—	—	—	—	—	—	—	—
Florida	136.5	54.0	74.5	8.0	—	—	—	—	—	—
Georgia	31.1	—	24.0	3.2	0.8	—	—	—	3.1	—
Hawaii	87.2	9.4	8.3	1.5	60.0	8.0	—	—	—	—
Idaho	37.6	19.6	18.0	—	—	—	—	—	—	—
Illinois	293.9	127.9	135.5	23.3	4.0	—	—	3.2	—	—
Indiana	40.3	5.6	10.5	22.0	—	—	—	0.2	—	—
Iowa	40.6	32.6	5.0	1.0	—	—	—	2.0	—	2.0
Kansas	40.1	1.2	0.8	8.8	19.2	—	—	9.1	1.0	—
Kentucky	67.0	—	36.0	16.0	—	—	—	—	—	15.0
Louisiana	54.4	26.8	2.0	20.0	5.6	—	—	—	—	—
Maine	43.8	—	39.6	4.0	—	—	—	—	0.2	—
Maryland	39.2	14.0	16.5	1.0	7.4	—	—	0.3	—	—
Massachusetts	65.0	19.3	17.0	13.7	9.0	—	3.0	3.0	—	—
Michigan	135.9	38.0	40.5	45.6	1.8	—	4.1	—	5.9	—

Minnesota	104.4	3.0	53.0	10.0	18.8	2.5	1.9	5.9	4.0	5.3
Mississippi	33.7	0.3	26.4	7.0	—	—	—	—	—	—
Missouri	51.6	2.0	32.5	5.1	—	—	—	—	12.0	—
Montana	39.4	—	39.3	0.1	—	—	—	—	—	—
Nebraska	10.7	—	7.5	3.2	—	—	—	—	—	—
Nevada	1.5	—	1.5	—	—	—	—	—	—	—
New Hampshire	16.7	10.5	5.2	1.0	—	—	—	—	—	—
New Jersey	94.2	56.3	1.3	16.1	20.5	—	—	—	—	—
New Mexico	24.0	—	24.0	—	—	—	—	—	—	—
New York	579.2	441.1	20.2	40.0	30.5	—	6.9	4.5	—	36.0
North Carolina	86.6	16.0	15.1	4.5	48.0	—	—	3.0	—	—
North Dakota	14.7	0.3	14.0	—	—	—	—	0.4	—	—
Ohio	26.3	7.0	15.5	3.2	—	—	—	0.6	—	—
Oklahoma	26.0	5.3	8.0	12.0	0.2	—	—	0.1	—	0.4
Oregon	52.4	—	51.3	0.6	—	0.5	—	—	—	—
Pennsylvania	102.8	50.9	23.4	4.5	19.9	0.7	1.0	0.7	1.0	0.7
Rhode Island	12.0	—	12.0	—	—	—	—	—	—	—
South Carolina	17.2	9.6	3.7	0.1	2.9	—	—	0.9	—	—
South Dakota	18.2	—	12.0	6.2	—	—	—	—	—	—
Tennessee	14.0	—	11.0	3.0	—	—	—	—	—	—
Texas	149.5	46.6	12.0	12.0	74.1	4.8	—	—	—	—
Utah	38.7	—	14.0	1.0	3.0	—	1.0	19.7	—	—
Vermont	18.0	8.3	8.7	—	1.0	—	—	—	—	—
Virginia	113.3	—	57.4	36.5	3.4	11.0	—	—	—	5.0
Washington	93.3	9.2	63.5	4.9	2.1	8.0	4.6	1.0	—	—
West Virginia	20.3	—	18.8	1.5	—	—	—	—	—	—
Wisconsin	91.8	40.6	42.0	0.5	8.7	—	—	—	—	—
Wyoming	12.1	—	9.0	0.1	3.0	—	—	—	—	—

Source: Research and Development in State Government Agencies, Fiscal Years 1967 and 1968, NSF 70-22.

APPENDIX G

FIFTY LOCAL GOVERNMENTS LEADING IN RESEARCH AND DEVELOPMENT EXPENDITURES, BY TYPE AND INDIVIDUAL LOCAL GOVERNMENT, AND FUNCTIONAL AREA, FISCAL YEAR 1968

(Thousands of dollars)

Type and individual government	Total	Health and hospitals	Educa- tion	Sanita- tion	Police and correc- tion	Municipi- pal utiliti- ties	Finan- cial adm. & gen'l control	Housing and urban renewal	Natural re- sources	High- ways	Public wel- fare	Other
Total	\$29,431	\$10,725	\$4,455	\$1,999	\$4,163	\$3,695	\$1,880	\$472	\$814	\$47	\$85	\$1,096
Municipalities	15,104	5,394	947	902	3,506	1,175	1,496	357	505	40	—	782
New York City, N.Y.	4,671	91	625	1	2,408	744	90	81	331	3	—	297
Boston, Mass.	840	735	—	—	—	—	—	105	—	—	—	—
Philadelphia, Pa.	2,306	2,129	—	6	—	41	7	4	119	—	—	—
Los Angeles, Calif.	1,692	—	—	221	830	104	46	4	3	37	—	—
Baltimore, Md.	755	523	—	—	8	100	124	—	—	—	—	448
Chicago, Ill.	836	429	9	—	141	—	257	—	—	—	—	—
San Francisco, Calif.	371	240	—	131	—	—	—	—	—	—	—	—
Detroit, Mich.	323	11	—	235	—	77	—	—	—	—	—	—
San Jose, Calif.	124	—	—	4	120	—	—	—	—	—	—	—
Dist. of Columbia	825	514	311	—	—	—	—	1	—	—	—	—
Milwaukee, Wis.	326	293	—	—	—	—	—	—	—	—	—	—
Lansing, Mich.	222	—	—	—	—	—	—	—	—	—	—	—
Hartford, Conn.	361	361	—	—	—	—	222	—	32	—	—	—
Jacksonville, Fla.	251	45	—	—	—	—	—	—	—	—	—	—
Minneapolis, Minn.	261	—	—	—	—	—	205	—	—	—	—	—
Wichita Falls, Tex.	104	—	—	—	—	—	261	—	—	—	—	—
Duluth, Minn.	200	—	—	103	—	—	—	—	—	—	—	—
Seattle, Wash.	87	—	—	—	—	—	200	—	—	—	—	1
All other	549	22	3	203	—	87	83	162	19	—	—	—
Counties	7,565	4,259	1,131	457	645	288	277	78	112	—	85	233

Los Angeles Co., Calif.	1,754	488	—	439	474	—	204	44	85	—	20	—
Cook Co., Ill.	2,185	2,185	—	—	—	—	—	—	—	—	—	—
Nassau Co., N.Y.	695	427	—	—	—	268	—	—	—	—	—	—
Fairfax Co., Va.	696	—	696	—	—	—	1	34	—	—	—	211
Dade Co., Fla.	247	—	—	—	—	—	—	—	—	—	—	—
Hennepin Co., Minn.	—	—	—	—	—	—	—	—	—	—	—	—
Anne Arundel Co., Md.	344	—	344	—	—	—	—	—	—	—	—	—
Santa Clara Co., Calif.	236	—	—	—	171	—	—	—	—	—	65	—
Essex Co., N.J.	10	10	—	—	—	—	—	—	—	—	—	—
Wayne Co., Mich.	173	173	—	—	—	—	—	—	—	—	—	—
Montgomery Co., Md.	221	221	—	—	—	—	—	—	—	—	—	—
All other	1,004	755	91	19	—	20	72	—	27	—	—	21
Special districts	3,237	154	—	640	—	2,098	108	—	156	—	—	81
Chicago, Ill. Transit Auth.	337	—	—	—	—	337	—	—	—	—	—	—
Met. Sanitary Dist. of												
Greater Chicago, Ill.	305	—	—	305	—	—	—	—	—	—	—	—
Allegheny Co., Pa. Port Auth.	866	—	—	—	—	866	—	—	—	—	—	—
Los Angeles Co., Calif.	190	—	—	190	—	—	—	—	—	—	—	—
Sanitation Dist.												
Met. Water Dist. of Southern												
Calif.	312	—	—	—	—	312	—	—	—	—	—	—
Alameda-Contra Costa, Calif.												
Transit Dist.	—	—	—	—	—	—	—	—	—	—	—	—
Minn.-St. Paul Sanitary Dist.	154	154	—	—	—	—	—	—	—	—	—	—
All other	1,071	—	—	145	—	582	108	—	156	—	—	81
School districts	2,376	—	2,376	—	—	—	—	—	—	—	—	—
Edgewood, Tex. Ind. Sch. Dist. ..	—	—	—	—	—	—	—	—	—	—	—	—
Austin, Tex. Ind. Sch. Dist.	67	—	67	—	—	—	—	—	—	—	—	—
Columbus City, Ohio Sch. Dist. ..	—	—	—	—	—	—	—	—	—	—	—	—
Toledo City, Ohio Sch. Dist.	88	—	88	—	—	—	—	—	—	—	—	—
Milwaukee City, Wis. Sch.												
Dist.	172	—	172	—	—	—	—	—	—	—	—	—
Broward Co., Fla. Bd. of												
Pub. Inst.	104	—	104	—	—	—	—	—	—	—	—	—

**FIFTY LOCAL GOVERNMENTS LEADING IN RESEARCH AND DEVELOPMENT EXPENDITURES,
BY TYPE AND INDIVIDUAL LOCAL GOVERNMENT, AND FUNCTIONAL AREA, FISCAL YEAR 1968—CON.**

(Thousands of dollars)

Type and individual government	Total	Health and hospitals	Educa- tion	Sanita- tion	Police and correc- tion	Munici- pal utili- ties	Finan- cial adm. & gen'l control	Housing and urban renewal	Natural re- sources	High- ways	Public wel- fare	Other
Denver City-Co., Colo. Sch. Dist. 1	\$ 261	—	\$ 261	—	—	—	—	—	—	—	—	—
San Jose City, Calif. Unif. Sch. Dist.	205	—	205	—	—	—	—	—	—	—	—	—
Clark Co., Nev. Sch. Dist.	137	—	137	—	—	—	—	—	—	—	—	—
Cincinnati City, Ohio Sch. Dist.	320	—	320	—	—	—	—	—	—	—	—	—
All other	1,023	—	1,023	—	—	—	—	—	—	—	—	—
Hospital districts and townships ..	1,149	918	—	—	12	134	—	37	41	7	—	—
Bexar Co., Tex. Hosp. Dist.	74	74	—	—	—	—	—	—	—	—	—	—
Marion Co., Ind. Health and Hosp. Corp.	436	436	—	—	—	—	—	—	—	—	—	—
Dallas Co., Tex. Hosp. Dist.	333	333	—	—	—	—	—	—	—	—	—	—
Hempstead twp., N.Y.	223	—	—	—	12	134	—	37	41	—	—	—
All other	81	74	—	—	—	—	—	—	—	7	—	—

Source: Research and Development in Local Governments, Fiscal Years 1968 and 1969, NSF 71-6.

**FULL-TIME EQUIVALENT NUMBER OF PERSONNEL ENGAGED IN RESEARCH
AND DEVELOPMENT IN LOCAL GOVERNMENTS, BY TYPE OF
LOCAL GOVERNMENT, FISCAL YEAR 1968**

<i>Type of government</i>	<i>Total</i>	<i>Scientists and Engineers</i>	<i>Technicians</i>	<i>Other¹</i>
Total	1,874.5	836.1	543.1	495.2
Municipalities	980.2	433.2	270.3	276.7
Counties	512.4	208.5	177.4	126.5
Special districts	102.3	40.9	45.4	16.0
School districts	173.5	107.1	17.6	48.8
Hospital districts	98.1	43.9	29.4	24.8
Townships	8.0	2.5	3.0	2.5

¹ Includes typists, clerks, and administrative personnel.

Source: Research and Development in Local Governments, Fiscal Years 1968 and 1969. NSF 71-6.

APPENDIX H

NATIONAL GOVERNORS' CONFERENCE

San Juan, Puerto Rico—September 1971

(From Enacted Policy Statements of the Committee on Transportation, Commerce and Technology—Governor Dan Evans, Chairman)

Technology

As the leading technological Nation, the United States generated tremendous new discoveries in many fields including medicine, communication, transportation, and data processing. Federal investment in programs such as space exploration and the supersonic transport involve large sums. Because of this public investment, technical discoveries should become available for maximum public benefit.

The Federal Government is the major supporter of programs which generate new technologies. There should be a program at the federal level to identify and document the opportunities and problems created by these developments. A vital part of this information system is channels of direct communication between those creating new technology and those seeking to adapt and apply it to public purposes.

To fully complement a federal technology information system, States must act either independently or through regional organizations. Using technically competent people, they must identify and describe problems of importance which could be favorably affected by application of technology.

Data processing has received the greatest attention to date of any new technology applied to government. A good program requires trained personnel employing specialized equipment within a fully analyzed system. Governments are hampered by the concentration of technicians in industry, by attempts to use non-specialized equipment for specific tasks, and by a tendency to make poor systems move faster instead of establishing superior systems.

There is a need for cooperation among Federal, State and local governments to produce the large market required by certain types of technology. Orders from many jurisdictions will reduce unit costs in each, and will make possible the manufacture of highly specialized equipment.

NATIONAL LEGISLATIVE CONFERENCE

24th Annual Meeting, Minneapolis, Minnesota, August 17-20, 1971

(See Resolution One, Summary of Proceedings)

WHEREAS, the National Legislative Conference and its committees on Intergovernmental Relations and Science and Technology; the National Conference of State Legislative Leaders; the National Society of State Legislators; the United States Advisory Commission on Intergovernmental Relations; and the Intergovernmental Science Relations Committee of the Federal Council on Science and Technology have endorsed federal research and development grants to State legislatures;

WHEREAS, the Office of Management and Budget has instructed all federal agencies to support R&D applications from state legislatures on an equal basis with other applications received; and

WHEREAS, only a few state legislature R&D projects have been supported by federal agencies;

BE IT RESOLVED, that the National Legislative Conference recommends:

(1) That federal agencies increase their support of R&D projects in state legislatures in areas such as environment, economic development, welfare, and human resource development where State governments have primary responsibilities in our federal system;

(2) That the National Legislative Conference strengthen its staff capability to assist individual state legislatures in the development and securing of federal R&D grants.

NATIONAL LEGISLATIVE CONFERENCE

24th Annual Meeting, Minneapolis, Minnesota, August 17-20, 1971

(See Resolution Two, Summary of Proceedings)

WHEREAS, science and technology are becoming increasingly important in the affairs of state government; and

WHEREAS, few states have developed R&D activities necessary to provide information necessary for informed government decision-making; and

WHEREAS, the Federal Government has been the primary source of government support of research and development in the United States; and

WHEREAS, many Federal functions for which the Federal Government is supporting research and development are being decentralized to the State and local Government levels under concepts of New Federalism; and

WHEREAS, the Committee on Intergovernmental Science Programs of the Federal Council of Science and Technology has recommended that the Federal Government enhance the research and development functions of State governments through providing funding to State governments;

BE IT RESOLVED, THEREFORE that the National Legislative Conference recommends that:

- a. The Federal Government, in cooperation with the Governors and Legislatures, develop and fund a program of R&D grants to the States;
- b. That a focal Federal agency be selected to administer the funding program in consultation with other Federal agencies, and that a national advisory committee composed of representatives of Federal, State and local Governments be established to provide policy and administrative guidance in implementing the grant program.

NATIONAL LEAGUE OF CITIES

Annual Meeting, Honolulu, Hawaii, November, 1971

(Extract from 1972 Municipal Policy—"Improving the Tools of Urban Research—Policies and Programs")

Urban research is needed to strengthen local government decision-making and program operation processes. We recommend the following actions for maximizing the contribution of science and technology to the solution of critical urban problems.

- A. Federal government agencies supporting scientific and technological programs relevant to the problems of local governments should formally incorporate the advice and judgments of representatives of these governments in the development of their policies and programs.
- B. The Federal government and local governments should join together in supporting the development and coordination of local science and technology mechanisms that would serve to augment local government capabilities for policy making, programming and implementation, including the review, development, assessment and application of scientific knowledge and technology in the public area.
- C. A joint Federal-local program should be established for

the support of in-house local governmental or contractual research on urban problems in a city setting, which would allow cities to utilize a wide-range of scientific and technological resources, both within and outside of the community.

- D. A Public Technology Clearinghouse should be established at the Federal level to assist local government elected officials and administrators find scientific and technological know-how in government, industry and the universities, and to develop systematic means for disseminating relevant urban research findings to local governments in a timely and systematic manner.
- E. The Federal government should develop and administer as a distinct entity a scientific and technical manpower program, perhaps utilizing in the main displaced scientists and engineers, which would focus on improving municipal ability to conduct, and be meaningfully involved in, municipal and technology utilization activities.

STATE COUNTY CITY SERVICE CENTER

Recommendations for Federal Assistance to State and local government, submitted by Mark Keane, Executive Director, International City Management Association and Chairman, State County City Service Center on behalf of the Council of State Governments, National Governors' Conference, National Association of Counties, National League of Cities, U.S. Conference of Mayors, and the International City Management Association.

1. Pertinent information must be acquired regarding those social and community problems where science and technology has proven useful, or where it is believed such techniques have a high potential. A regular reporting mechanism must be established for the dissemination of information from such programs and activities.
2. A vital requirement is a careful review of the state-of-the-art to be undertaken in light of State and local government requirements both present and future. Experience has shown that some technologies cannot be produced within a reasonable price range, endure the conditions under which they must function, or meet exigencies of some of the problem situations which exist. The time and costs required to create and convert technological components responsive to the special needs of State and local government must be measured carefully.

3. The third requirement is for a widespread sustained program of orientation and education for State and local officials, Federal program administrators, and leaders from the industrial and academic worlds. The utilization by State and local government of private resources—as well as more apparent forms of Federal assistance—must be examined.
4. Legislative action by the Federal government should be taken to strengthen research and development programs, and initiation of “pilot” projects designed to apply science and technology to selected State and local government problems. In the past, some laws have encouraged the development and use of technology but with no provision for funding and technical assistance which are critical to the continuance and success of a project.
5. Unless State and local governments are made full partners in programs to develop their scientific and technological ability, such programs will fail.

APPENDIX I

"STRONGER FEDERAL, STATE AND LOCAL PARTNERSHIPS"

*(Excerpt, Presidential Message on Science and Technology,
March 16, 1972.)*

A consistent theme which runs throughout my program for making government more responsive to public needs is the idea that each level of government should do what it can do best. This same theme characterizes my approach to the challenges of research and development. The Federal Government, for example, can usually do a good job of massing research and development resources. But State and local governments usually have a much better "feel" for the specific public challenges to which those resources can be applied. If we are to use science and technology effectively in meeting these challenges, then State and local governments should have a central role in the application process. That process is a difficult one at best; it will be even more complex and frustrating if the States and localities are not adequately involved.

To help build a greater sense of partnership among the three levels of the Federal system, I am directing my Science Adviser, in cooperation with the Office of Intergovernmental Relations, to serve as a focal point for discussions among various Federal agencies and the representatives of State and local governments. These discussions should lay the basis for developing a better means for collaboration and consultation on scientific and technological questions in the future. They should focus on the following specific subjects:

- 1) Systematic ways for communicating to the appropriate Federal agencies the priority needs of State and local governments, along with information concerning locally-generated solutions to such problems. In this way, such information can be incorporated into the Federal research and development planning process.

- 2) Ways of assuring State and local governments adequate access to the technical resources of major Federal research and development centers, such as those which are concerned with transportation, the environment, and the development of new sources of energy.

- 3) Methods whereby the Federal Government can encourage the aggregation of State and local markets for certain products so that industries can give government purchasers the benefits of innovation and economies of scale.

The discussions which take place between Federal, State and local representatives can also help to guide the experimental programs I have proposed for the National Science Foundation and the National Bureau of Standards. These programs, in turn, can explore the possibilities for creating better ties between State and local governments on the one hand and local industries and universities on the other, thus stimulating the use of research and development in improving the efficiency and effectiveness of public services at the State and local level.

65